Stanford's), should all deviate little from the 400-feet contour line.

The volume is full of minute observations and acute remarks. Readers will find many cherished beliefs rudely handled; perhaps may feel some of them shaken. What a heresy is his denial of the three-fold division of the Drift. In disbelief of interglacial periods he has had predecessors. Herr Penck will find the assertion that frequent and finely striated stones in a clay are an argument against that clay being ground-moraine. Neither contortions nor groovings are here invariably ascribed to a glacier; on the contrary, he explains most such when they occur as products of his lakes or his moraines. He has seen no evidence (in Switzerland) for glacier excavation (of lakes). He expresses opinions freely and forcibly: it is refreshing to read that "much rubbish has been written on the Cromer cliffs." The doctrine of a post-pliocene great marine submergence he believes "the most pernicious one ever propounded in geology." Amusing is his description of the "remarkable properties of this sea, wholly unlike any known sea. It made till and eroded till: it filled some regions with drift, while others it cleared utterly of all drift; its icebergs made striæ, while its waters washed them away." It is true that like language might be applied to the effects of glaciers, as described by some of their admirers. Probably it did not occur to him that with regard to them any expression of opinion was needed.

The author's own views offer points for an opponent's attack. While he cannot induce himself to believe in a thousand feet of submergence, it seems to him simple for Scotch ice to have climbed a thousand feet up a Welsh hill, and easy for it to have pushed portions of the sea-bottom to the top. He repeatedly distinguishes between clay formed under a glacier (till) and clay formed in a glacier lake (boulder-clay). But when he sees only till at Filey, and only boulder-clay in East Anglia, it is not easy to make out which of their points of difference are the critical ones. He makes several references to striæ as indicating direction of ice-motion. Yet his ultimate conclusion appears to be that the shape of the striæ depends only on the slope of the rock, and, except on level ground, gives no guide to the direction of motion. He frequently insists on the effects of great floods and débâcles which would result from his glacier-dam lakes, but he does not indicate the way in which these catastrophes would be brought about. "I believe," he says, "that the Scandinavian ice-sheet would temporarily dam up the Humber and form a great inland lake, which would pour over the country to the south in débâcles, making gravels. . . . ." The water would rise steadily to a level of overflow, but how would a débâcle be thereby produced? Such floods seem no necessary part of his theory; however, his belief in them is firm.

To decipher field notes intended only for the writer's own eye, must have been a most difficult task. It has been performed with remarkable success: of course, mistakes have not entirely been avoided, but probably each will be obvious to and easily corrected by any reader who is concerned with the case. In the illustrations on pages 322–4, some clays are marked "Permian." There is no Permian clay in that neighbourhood; the word should evidently be Pennine, a designation for a division of the Midland boulder-clay.

Prof. Carvill Lewis began his studies in Pennsylvania, and there obtained his conceptions of moraines as "high-tide marks" for glaciers. He came to the British Isles for explanations of phenomena which perplexed him in America. In Ireland he sought and thought he found a solution of Transatlantic problems. He extended his researches over England and Scotland, and visited the Alps to see existing glaciers. The ideal order of study would be to begin by learning all about ice, and then applying the acquired knowledge to these questions. But practically all, even Carvill Lewis, begin upon deposits said to be glacial, though all do not go on to examine actual ice; and very few can study its grandest manifestations. It is much to be wished that such a geologist as he could spend some summers and winters round Greenland and Hudson's Bay. If to this he could add an acquaintance with Antarctic ice, he would have an equipment of appropriate knowledge such as no one has yet brought to bear on the question. Yet even so there is, perhaps, no spot on the earth where we can now see a glacier advancing across unglaciated lands: a cause whose effect is freely invoked by various writers on this question. However, we must use as best we can such means as we possess. Two characteristics of Carvill Lewis seem especially worthy of our imitation, viz., his untiring assiduity—we are told that he traversed the country between Cork and Mallow six separate times; and his readiness to acknowledge mistake and correct it—he completely retracts more than one opinion at first freely expressed. If any critic had condemned this as "a complete change of front," he would probably have answered, "I am ready to front any way where I see a road to truth."

An estimate of the advance which this book will have made towards a full and true theory is only possible to an infallible critic. His idea, that there ought to be a definite mark of the furthest extension of a glacier, seems to me a correct one: if so, such marks should be sought for. His clear conception of the power and action of floating ice deserves to be studied and developed. His distinctions between the products beneath an ice-sheet (till), adjacent to an ice-sheet (moraine), beyond the ice-sheet, but in waters washing it (boulder clay), are real distinctions of the highest importance. Surely there must be criteria of difference, whether the author has arrived at them or not. Surely when such criteria are ascertained, we shall be very near the solution of one side of the glacial problem. Still would remain for study another side: What brought that problem into existence; what was really the cause of the Ice Age?

E. HILL.

UNIVERSITY EXTENSION.

Aspects of Modern Study. Pp. 187. (London: Macmillan and Co., 1894.)

THIS volume consists of addresses delivered by Lord Playfair, Sir James Paget, Prof. Max Müller, the Duke of Argyll, and Canon Browne, among others, to students of the London Society for the Extension of University Teaching, at annual meetings held at the

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Mansion House since 1886. In most of the addresses, special aspects of study are considered, but those by Lord Playfair and Canon Browne deal with the Extension movement itself.

Men of science, as a rule, look askance at University Extension lectures. They know that there is no royal road to scientific knowledge, and believe that popular lectures of a "peep-show" kind have no place in a properly organised educational system. This is true to some extent. Popular lectures of any sort, whether delivered at the Royal Institution or in a village club, are of little use to the practical student of science. They are useful, however, in bringing people into touch with current opinions, and in creating an interest in scientific things.

The subject of Lord Playfair's address is the evolution of University Extension as a part of popular education. After people have heard lectures, they desire to found institutions in which instruction is regularly given. Out of the single and unconnected penny readings in the early part of this century grew the Mechanics' Institutes that, in the Midlands and the North, have helped on the cause of education. It was, of course, inevitable that the committees of these institutes should sometimes have had queer ideas as to the kind of programme which should be offered to the community. Lord Playfair says that one of the most prosperous of them asked him to give a single lecture on chemistry in 1846, and sent him the programme for the preceding year as an inducement to accept the invitation. It was as follows :—"Wit and Humour, with Comic Songs—Women Treated in a Novel Manner—Legerdemain and Spirit-rapping—The Devil (with illustrations)—The Heavenly Bodies and the Stellar System—Palestine and the Holy Land—Speeches by Eminent Friends of Education, interspersed with Music, to be followed by a Ball. Price to the whole 2s. 6d. Refreshments in an Anteroom." Even now, programmes of this motley character can be found at many of the large workmen's clubs in the East End, and though most educationists consider them to be "awful examples," the fact that the science lectures are usually very largely attended testifies to a desire for knowledge, which often leads to systematic study. The University Extension scheme has certainly done something to mould this demand for popular instruction. When interest has been awakened by a pioneer lecture, it becomes a comparatively easy matter to run a successful course of six or twelve lectures. And if such courses are linked together in proper sequence, it cannot be denied that advantage must accrue from them. For, to use a simile of Lord Playfair's, not only does the lecturer scatter information broadcast among his audience, trusting that some of it will fall on fertile soil, but, in the class after each Extension lecture, he acts as a tutor and is able to treat the students individually, giving each mind the attention conducive to the production of good results. The great difficulty, however, is with regard to practical work. Every man of science feels that, so far as serious study is concerned, lectures should take a secondary place in a scheme of instruction. Observations in the field, laboratory, or observatory, are absolutely necessary for a proper appreciation of the facts and phenomena of nature; and, until some provision is made for this kind of work, the science lectures will be considered little more than a form of recreation.

Sir James Paget's address is concerned with the study of science. He points out that a scientific mind should be educated in four ways, viz. (1) in the power of observing, (2) in accuracy, (3) in the difficulty of ascertaining truth, (4) in proceeding from the knowledge of what is proved to the thinking of what is probable. The subject of Prof. Max Müller's address is "Some Lessons of Antiquity," and that of the Duke of Argyll, "The Application of the Historical Method to Economic Science." The addresses are interesting from many points of view, and they help to define the *rôle* of courses of University Extension lectures in our educational system.

R. A. GREGORY.

SOME RECENT WORKS ON ELECTRICITY.

(1) *Electric Traction on Railways and Tramways.* By Anthony Reckenzann, C.E. (London: Biggs and Co.)

(2) *Portative Electricity.* By J. T. Niblett. (London: Biggs and Co.)

(3) *First Principles of Electrical Engineering.* By C. H. W. Biggs. New edition, partly rewritten and extended. (London: Biggs and Co.)

(4) *Electrical Distribution, its Theory and Practice.* Part i., by Martin Hamilton Kilgour. Part ii., by H. Swan and C. H. W. Biggs. (London: Biggs and Co.)

(5) *Town Councillors' Handbook to Electric Lighting.* By N. Scott Russell, M.Inst.C.E. (London: Biggs and Co.)

(1) THE present state of electric traction is precisely given, and the various methods and constructive details at present in use described. The best modern examples of traction are explained, with many excellent illustrations. In particular may be mentioned the proposed St. Louis and Chicago high-speed electric railway, designed to convey passengers 250 miles in two and a half hours. Much useful information has been collected from the various electrical journals and *Transactions*, and a handbook formed, which is sure to be of great service to practical men. We notice that the words "energy," "power," and "work" are used in the popular rather than in the exact scientific sense; but this circumstance detracts little from the value of the work.

(2) This little work is described as being "A Treatise on the Application, Methods of Construction, and the Management of Portable Secondary Batteries." It has been written mainly for the benefit of those who find this form of stored energy of service for economic, artistic, or scientific purposes. Part i. deals with applications to mining operations, domestic use, medical and other scientific purposes, the Army and Navy, carriage lighting, and traction and decoration. In a popular form we are presented with much information that will be very useful to anyone contemplating some of these special uses of electricity. Many of these are recent and novel, and not to be found in any other work with which we are acquainted.

Part ii. is occupied with the description and management of primary and secondary batteries and their

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